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1. A method for providing tactile force feedback in response to a user position and orientation, the method comprising the steps of:

storing data representative of a computer model, including one or more objects having surfaces;

generating an electrical signal for each of a plurality of degrees of freedom of the user as a function of the user position and orientation;

synthesizing user velocity and acceleration from the electrical signals to determine user-applied force;

mapping the user position, orientation and applied force with respect to computer model to determine interactions between the user and any objects included in the model;

generating at least one force field in response to the interactions;

generating a force signal for each degree of freedom as a function of the force field; and

directing a tactile force on the user for each force signal, the generated tactile forces providing the tactile feedback.

2. The method of claim 1 wherein the number of degrees of freedom is two or more.

3. The method of claim 2 wherein the step of generating the electrical signals includes the step of sensing position and orientation of the user's hand and wherein the tactile forces are directed to the user's hand.

4. The method of claim 1, wherein the step of synthesizing user velocity and acceleration from the electrical signals to determine user-applied force includes the step of sampling the electrical signals at regular intervals to synthesize estimates of user velocity and acceleration.

5. The method of claim 1, further including the step of computing a torque contribution associated with each degree of freedom based upon user position, orientation and applied force to assist in determining the interaction between the user and any objects of the model.

6. The method of claim 5, further including the step of applying the torque contributions to a running sum of such contributions.

7. The method of claim 1, further including the step of generating an altered force field view by performing a mathematical transformation on the position and orientation data.

8. A system for providing tactile force feedback in response to a user position and orientation, the system comprising:

a multi-axis interface device including an actuator for each axis and a member movable by the user, the interface device being responsive to the position and orientation of the member to generate electrical signals representative of the position and orientation of the

member; and

10 a programmed computer operative to:
12 store data representative of a computer
12 model, including any objects associated therewith,
14 analyze the position and orientation of the
14 member relative to the objects to determine any interaction
therebetween,
16 generate at least one force field in
response to the interaction, and
18 generate a force signal for each axis of the
device as a function of the force field, wherein the
20 actuators are responsive to their respective force signals
to provide a force to each axis of the device for creating
22 the force feedback.

2 9. The system of claim 8 wherein the computer
model is associated with computer-aided design.

2 10. The system of claim 8 wherein the member
includes a handle gripable by the user.

2 11. The system of claim 8 wherein the virtual
reality force field includes limits and stops implemented
by the computer program.

2 12. The system of claim 11, including a force
limit based upon velocity.

2 13. The system of claim 11, including a power
limit based upon the integral of average power consumption

with respect to time.

2 14. The system of claim 8 wherein the means for
generating is capable of generating a plurality of force
4 fields, and wherein the member includes a switch means for
selecting one of the force fields.

2 15. A locally self-contained system for
providing tactile feedback in response to a user position
and orientation, comprising:

4 (a) a multi-axis, user-moveable member including
an actuator and position sensor dedicated to each axis;

6 (b) an interface device in communication with
each actuator and each position sensor, the interface
8 device being operative to:

10 generate an electrical signal representative of
the position and orientation of the member, and

12 activate one or more of the actuators in response
to a received force signal;

14 (c) a programmed computer in communication with
the interface device, the computer being programmed to
perform the following functions:

16 receive an electrical signal from the
interface device representative of the position and
18 orientation of the member with respect to time,

20 determine a user-applied force to the member
by synthesizing velocity and acceleration from the periodic
position readings,

22 generate at least one virtual reality force
field in response to the user-applied force,

24 generate a force signal as a function of the
force field, and
26 output the force signal to the interface
device.

16. The locally self-contained system of claim
2 15, wherein the actuator and position sensor associated
with a particular axis are in physical communication with
4 one another, enabling the superposition of translational
displacement with force application, and angular
6 displacement with torque, thereby permitting an arbitrary,
programmed application of forces, torques and displacements
8 to the member in any direction.

17. The method of balancing the power
2 consumption of a manipulator having a peak torque mode and
an average power rating in a tactile-feedback environment,
4 comprising the steps of:

operating the manipulator primarily in the peak
6 torque mode;

at least periodically integrating the average
8 power consumed by the manipulator as a function of time;
and

10 backing off from the peak torque mode, at least
momentarily, in the event the average power rating of the
12 manipulator has been exceeded.

18. The method of claim 17, including the step
2 of continuously integrating the average power consumed by
the manipulator as a function of time.